

Technical Attachment

**Ground-Level Ozone In Central Arkansas:  
“Ozone Action Days” and the Meteorological  
Conditions which Contribute to High Ozone Levels**

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**1. Introduction**

This paper examines ground-level ozone, “Ozone Action Days” (a program which is aimed to curb ozone levels in central Arkansas), and the meteorological conditions which contribute to high ozone levels in central Arkansas.

**2. Ground-Level Ozone**

Ozone is not directly emitted into the atmosphere. Instead, it is formed in the presence of sunlight by a chemical reaction between oxides of nitrogen and volatile organic compounds. Major contributors to the development of ground-level ozone are industrial commercial processes, motor vehicle emissions, and consumer solvents (U.S. EPA 2001).

Ozone at the earth’s surface can be harmful to both humans and the environment. Over-exposure to ozone can cause many side effects in humans, such as chest pains, coughing, nausea, and difficulty in breathing. Potential environmental impacts of ozone include damage to plant life and crops. Ozone is also the primary ingredient in smog formation (U.S. EPA 2001).

Because of these factors, the Environmental Protection Agency (EPA) has taken various measures in the pursuit of reducing ground-level ozone levels across the country. To bring about public awareness of ozone levels in cities across the country, the EPA instituted an Air Quality Index (AQI) which characterizes the ozone level for a given day. The AQI has six categories, ranging from “good” to “hazardous.” If a city continually has ozone levels which exceed EPA standards, government mandates will be instituted in order to bring about a reduction of ozone levels. In order to avoid these mandates, many city and state agencies across the United States have instituted other public awareness methods to help in curbing ground-level ozone concentrations. In central Arkansas, one such program is “Ozone Action Days” - OAD (U.S. EPA 2000).

**3. Ozone Action Days (OAD)**

The OAD program in central Arkansas is coordinated through Metroplan and the Central Arkansas Cities Coalition, in cooperation with the Arkansas Department of Health (ADH), Arkansas Department of Environmental Quality (ADEQ), and the Arkansas State Highway and Transportation Department (AHTD). The goal of OAD is to increase public awareness of ozone- related health

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risks along with reducing the use of agents responsible for the production of ground-level ozone in the Little Rock metropolitan area, including Pulaski, Faulkner, Lonoke and Saline counties (ADEQ 2001).

There are two types of “Ozone Action Days” that ADEQ can declare, depending on the AQI level that is forecast. An *Ozone Action Advisory* is declared when the AQI is forecast to reach or exceed 85 parts per billion, averaged over an eight-hour period. This falls into the “Unhealthy for Sensitive Groups” category on the AQI scale. An *Ozone Action Alert* is declared when the AQI is forecast to reach or exceed 105 parts per billion, averaged over an eight-hour period. This falls into the “Unhealthy for Everyone” category on the AQI scale (ADEQ 2001).

The challenge that ADEQ faces is in accurately forecasting when ozone levels in central Arkansas will reach these dangerous levels, resulting in a need to declare either an *Ozone Action Advisory* or *Ozone Action Alert*. Knowledge of the meteorological conditions which lead to high ozone levels is essential for ADEQ. The National Weather Service Forecast Office (WFO) in Little Rock has worked together with ADEQ in the pursuit of reducing ozone levels.

#### **4. Data Analysis**

At WFO Little Rock, 16 years of data (1981-1996) were analyzed to determine the meteorological conditions which contribute to high ozone levels in central Arkansas. The following days were included in the data analysis.

1. Any day on which the ozone concentration equaled or exceeded 70 parts per billion (ppb). This level is generally considered the threshold at which sensitive groups (such as asthma sufferers) begin to be affected by ground-level ozone.
2. Any day preceding or following a day on which the ozone concentration equaled or exceeded 70 ppb. This was done to study what meteorological variables changed, leading to either an increase or decrease in the ozone concentrations.

A total of 534 days were analyzed for the months of May, June, July, August and September from 1981-1996. By months, the days were broken down as follows: May 38, June 184, July 130, August 124, September 58. May through September has the greatest frequency of high ozone levels in central Arkansas. Appendix 1 shows the number of days of  $\geq 70$  ppb ozone concentration for May - Sept. 1981-1996.

Twelve meteorological variables were analyzed, including: maximum temperature, dewpoint, percentage of sunshine, wind speed and direction, lifted index, CAPE, K Index, cap strength, 0-6 km mean wind, inversion height, and helicity. Each variable was studied to determine its relationship to ozone levels and changes in ozone levels.

## **5. Results of the Data Analysis**

It was determined that the five meteorological variables of most importance in determining the ozone concentrations for a given day in central Arkansas were the following.

1. Wind speed and direction
2. Maximum temperature
3. Percentage of sunshine
4. Temperature inversion height
5. Cap strength

Appendix 2 shows the “Ozone Action Day Checklist” which was developed by WFO Little Rock. Data contained in this checklist summarize the specific meteorological conditions which contribute to high ozone levels for the months of May through September. In general, ozone concentrations tend to reach their highest levels in central Arkansas on days where wind speeds are light and the direction has an easterly component, temperatures are in the middle 80s or higher, the temperature inversion height is below 800 mb, and the cap strength is 1 deg C or greater.

This is one tool that ADEQ uses to determine whether or not to issue an Ozone Action Advisory or Ozone Action Alert for central Arkansas.

Once ADEQ issues either an Ozone Action Advisory or Ozone Action Alert, WFO Little Rock communicates this information to the public via NOAA Weather Radio (NWR). The scripts that are read on NWR are included in Appendix 3.

## **6. Summary**

WFO Little Rock has been working with ADEQ in the pursuit of reducing ground-level ozone in central Arkansas. Data were analyzed to determine the meteorological conditions which promote the production of ground-level ozone. An Ozone Action Day Checklist, summarizing the meteorological conditions which help create high ozone levels, was compiled as a result of the data analysis. This checklist helps ADEQ determine future concentrations of ground-level ozone, based on meteorological conditions. Upon the issuance of either an Ozone Action Advisory or an Ozone Action Alert by ADEQ, WFO Little Rock then communicates these statements to the public via NWR. By making the public aware of high ozone levels, citizens can take appropriate actions to prevent their own health-related problems and to help reduce ground-level ozone in central Arkansas.

## **7. References**

ADEQ: State of Arkansas Department of Environmental Quality. 07 July 2001.  
<http://www.adeq.state.ar.us/air/ozone/ozonedays.asp>

United States Environmental Protection Agency. Air Quality Index: A Guide to Air Quality and Your Health. June 2000.

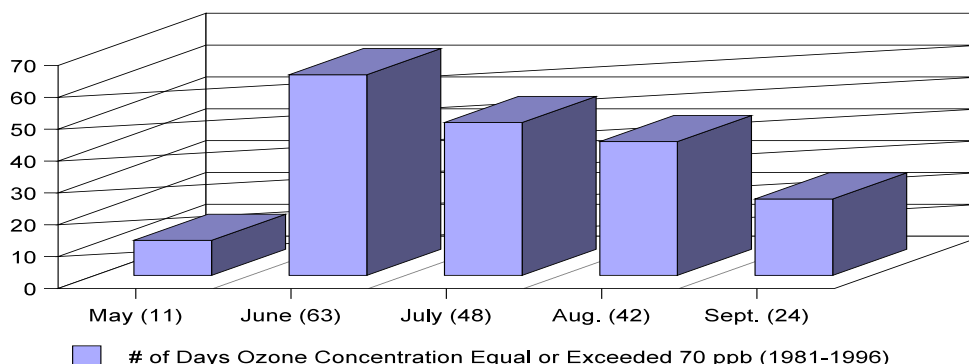
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## 8. Acknowledgments

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### Appendix 1: Number of Days $\geq 70$ ppb Ozone Concentration for May - September (1981-1996)



### Appendix 2: Ozone Action Day Checklist Developed by WFO Little Rock

Ozone Action Day Checklist								
	May	June	July	August	Sept.	Zone Fest	MOS	Yes/No
<b>Avg Wind Speed (mph)</b> Today Tomorrow	<6	<5	$\leq 4$	$\leq 5$	<7			
<b>Wind Direction (<math>^{\circ}</math> from)</b> Today Tomorrow	040 - 190	040 - 150	040 - 140	040 - 140	050 - 140			
<b>Max. Temp. (<math>^{\circ}</math>F)</b> Today Tomorrow	>83 >85	$\geq 86$ >88	$\geq 87$ >90	>85 >90	$\geq 83$ $\geq 88$			

<b>Sunshine (%)</b> Today Tomorrow	>85 >90	>80 >80	>85 90 - 100	>95 >75	>80 >85			
<b>Inversion Height (millibars)</b>	below 800	below 800	below 800	below 850	below 800			
<b>Cap Strength (°C)</b> Today Tomorrow	>3.5 >3.5	>0 >0+,>4++	>1+ >2++	>1+ >4++	>2 >3			
<b>Ozone Concentration (ppb)</b> Yesterday's Maximum Today's Maximum	>0.070	>0.70	>0.070	≥0.070	≥0.070			
<b>Recommendation</b> Action/No Action Extend Action Stop Action								
<b>Comments</b>								

### Appendix 3: Statements Read on CRS to Inform the Public of High Ozone Levels

#### Ozone Action Advisory

Today's air quality index is code orange, which means "It's time to get serious about ozone pollution" in central Arkansas. The Arkansas Department of Environmental Quality and the Arkansas Department of Health have declared an Ozone Action Advisory effective until 9:00 p.m. today in Pulaski, Faulkner, Lonoke and Saline counties. Code Orange conditions are unhealthy for sensitive groups. Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion today. Symptoms of ozone exposure may include shortness of breath, coughing, wheezing, headaches, nausea, and eye and throat irritation. To help reduce ozone formation, consider car pooling, walking or riding the bus. Avoid driving at lunchtime. Postpone or combine errands. Keep your car well tuned and avoid jackrabbit starts and excessive idling. Refuel motor vehicles and mow lawns during the late afternoon or evening hours only. (Developed by Metroplan.)

#### Ozone Action Alert

Today's air quality index is code red, which means "It's time to get serious about ozone pollution" in central Arkansas. The Arkansas Department of Environmental Quality and the Arkansas Department of Health have declared an Ozone Action Alert effective until 9:00 p.m. today in Pulaski, Faulkner, Lonoke and Saline counties. Code red conditions are unhealthy for everyone. Active children and adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion today; everyone else, especially children, should limit outdoor exertion. Symptoms of ozone exposure may include shortness of breath, coughing, wheezing, headaches, nausea, and eye and throat irritation. To help reduce ozone formation, consider car pooling, walking or riding the bus. Avoid driving at lunchtime. Postpone or combine errands. Keep your car well tuned and avoid jackrabbit starts and excessive idling. Refuel motor vehicles and mow lawns during the late afternoon or evening hours only. (Developed by Metroplan.)